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RETHINKING FASCAM -- PRINCIPLES FOR THE USE OF ARTILLERY DELIVERED MINES

A Monograph

by

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First Term AY 88-89

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION School of Advanced Military Studies, USACGSC 6b. OFFICE SYMBOL (If applicable) ATZL-SWV	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Fort Leavenworth, Kansas 66027-6900	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
Rethinking FASCAM- Principles for the use of Artillery Delivered Mines (U)

12. PERSONAL AUTHOR(S)
Major Mark T. Kimmitt, USA

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Monograph	FROM ____ TO ____	88/11/18	59

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Mine/Countermine, FASCAM, Scatterable Mines, Barrier Planning, Fire Support, Smart Munitions, Artillery Planning

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This monograph addresses existing shortcomings in the principles for employment of scatterable and remotely delivered mines. Such mines, part of an overall revolution in the conduct of land mine warfare, are an integral component of the deep, close and rear battlefields. Yet, the doctrine and principles of these mines has not kept pace with the advances in land mine technology.

One area in which this is abundantly clear is in the use of Field Artillery weapon systems to deliver scatterable mines. While the Field Artillery has made great advances in the development and integration of such systems as precision guided munitions and advanced artillery data technology, the RAAM (Remote Anti-Armor Mine) and ADAM (Area Denial Artillery Munition) systems lack adequate doctrine and principles to fully exploit their potential on the battlefield.

The author argues for the development of thorough and consistent doctrine for the use of Artillery scatterable mines. As one component in a triad of delivery systems, the artillery

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Major Mark T. Kimmitt	22b. TELEPHONE (Include Area Code) (913) 651 4773 22c. OFFICE SYMBOL ATZL-SWV

19. (Cont) may be the most responsive and flexible leg of that triad, but it is also the most vulnerable. Further, the lack of true interchangeability between the delivery systems may obviate the lack of redundancy within the entire mine warfare system.

The author concludes by developing a number of principles and guidelines for employment of artillery delivered mines, fully consistent with the shortcomings in the artillery delivery system. Furhter, he challenges the artillery community to continue discussion of these principles in order to generate a clear, consistent vision for the employment of artillery delivered mines.

Rethinking FASCAM--

Principles for the use of Artillery Delivered Mines

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18 November 1988

School of Advanced Military Studies
Monograph Approval

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Title of Monograph: Rethinking FASCAM--Principles for the use of Artillery Delivered Mines

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Accepted this 16th day of December 1988.

ABSTRACT

Rethinking FASCAM-- Principles for the use of Artillery Delivered Mines by Major Mark T. Kimmitt, USA, 59 pages.

This monograph addresses existing shortcomings in the principles for employment of scatterable and remotely delivered mines. Such mines, part of an overall revolution in the conduct of land mine warfare, are an integral component of the deep, close and rear battlefields. Yet, the doctrine and principles of these mines has not kept pace with the advances in land mine technology.

One area in which this is abundantly clear is in the use of Field Artillery weapon systems to deliver scatterable mines. While the Field Artillery has made great advances in the development and integration of such systems as precision guided munitions and advanced artillery data technology, the RAAM (Remote Anti-Armor Mine) and ADAM (Area Denial Artillery Munition) systems lack adequate doctrine and principles to fully exploit their potential on the battlefield.

In schoolhouse exercises and FTX's worldwide, the lack of such doctrine is reflected in ad hoc, highly personal approaches to FASCAM (Family of Scatterable Mines) employment. While the lack of any wartime testing of these systems precludes definitive doctrine on the subject, most often these systems are employed without fully understanding their potential or shortcomings.

The author argues for the development of thorough and consistent doctrine for the use of artillery scatterable mines. As one component in a "Triad" of delivery systems, the artillery may be the most responsive and flexible leg of that triad, but it is also the most vulnerable. Further, the lack of true interchangeability between the delivery systems may obviate the lack of redundancy within the entire mine warfare system. (LR)

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INTRODUCTION

The decade of the 1980's witnessed a revolution in land mine warfare. In the past, the land mine was but one of the many elements in an overall obstacle plan. Employed with concertina wire, tank ditches and road craters, land mines have been an effective, if unsophisticated, method of slowing or halting armored columns, harassing troop formations and eliciting fear well beyond their casualty effects. Every analysis of battlefield experience involving mines against tanks, vehicles and personnel has shown mine warfare's impressive contribution to total losses.

From WWII to Vietnam the underlying technology of anti-tank and anti-personnel mine remained virtually unchanged. Within the past ten years, however, mine warfare entered a second generation. The advent of scatterable and remotely deliverable mines, "smart" sensing options and a profusion of delivery systems has changed the nature of land mine warfare forever.

Recognizing these innovations, the U.S. Army published TRADOC Pamphlet No. 525-19 U.S. Army Operational Concept for Land Mine Warfare to:

> "..set forth an operational concept for the conduct of land mine warfare between now and 1995 (and) provide fundamentals for land mine warfare during the period covered by the AirLand Battle 2000 Concept (1995-2015)."[1]

A well-written framework for guiding the development of modern doctrine, the Operational Concept recognized that the objectives of land mine warfare had not

changed, in fact had expanded, and the capabilities of land mines to fulfill those objectives had also increased dramatically.

The Operational Concept recognizes, but fails to reconcile, a number of deficiencies in land mine warfare. Fundamentally, the army advanced a concept that limitations in weapon systems, platforms and personnel may prove to be its undoing. While commanders in the field are planning for the use of second generation mine systems, careful examination reveals extensive shortcomings in capabilities needed for their use.

One shortcoming is in the use of Field Artillery systems to fire scatterable mines in support of the close battle. A tremendous asset to the maneuver commander, the ability to call for minefields as he calls for other artillery fires adds a degree of flexibility and agility never previously available. Whether bringing an anti-tank minefield directly on attacking enemy formations, reseeding breached obstacles or closing potential avenues of approach, the capabilities of the Field Artillery to increase the firepower options available to the maneuver commander have dramatically improved with the advent of artillery delivered mines. In countless exercises conducted in the field and in the schoolhouses, plans are written and notionally executed with full employment of scatterable mines, commonly known but imprecisely termed FASCAM. Unfortunately, the lack of thorough and specific doctrine means that opinions, not tested facts, determine the best way to employ such mines on the battlefield. While the debate and discussion which inevitably surrounds the use of FASCAM on schoolhouse terrain boards often leads to

innovative solutions, one can't help wondering if the qualities and merits often accredited to modern land mine systems would survive a real world test.

The objective of this paper is to examine these revolutionary developments in mine warfare technology and doctrine, focusing on the Field Artillery contribution to that doctrine. I hope to demonstrate the wide disparity between the assumed and actual capability of the Field Artillery to function as a major component of the mine warfare system. Following an analysis of the shortfalls in current artillery mine doctrine and technology (or what is more commonly perceived to be the current doctrine), I hope to articulate more reasonable, albeit less sanguine, principles for the employment of artillery delivered minefields.

THE REVOLUTION IN LAND MINE TECHNOLOGY

The revolution in land mine warfare centers on two areas- technological improvements of the mine and an expansion in the number of delivery systems. Extensive use of new materials has made the mine smaller, more difficult to detect and defeat and more deadly. Each of these factors has made the art of landmine warfare more precise and more predictable. Remote control options, self-destruct mechanisms, discriminating fuses-- all of these components radically change the methods by which land mines can be employed.

However, the true tactical revolution in mine warfare has been in the proliferation of new delivery systems. For centuries a weapon system that required

difficult and laborious hand emplacement, minefields were constrained in size to the time and capacity of the infantry and engineers to dig the craters, emplace the mines, set the fuzing options and, if necessary, remove them afterward. Today, the reduced size and weight of the mines allow for rapid delivery and emplacement by a number of systems. An overview of existing and planned systems includes:

MOPMS

The Modular Pack Mine System (MOPMS) is a 150 pound suitcase-shaped mine dispenser which can be emplaced manually at any time prior to dispensing mines. The mines are dispensed on command using an M71 remote control unit or an electronic initiating device. The MOPMS, when activated, provides for a 35m radius minefield, scattering 17 Anti-Tank (AT) and 4 Anti-Personnel (AP) mines per dispenser. The MOPMS will be issued as a Class V item, while the M71 remote control unit will be issued as a TOE item to engineer companies (4 each), armor, infantry and cavalry units (2 each) and other companies with a protective mining mission (1 each).[2]

M128 GEMMS

The Ground Emplaced Mine Scattering System consists of an M128 dispenser unit, M74 AP and M75 AT self destruct mines. The dispenser unit is mounted on a 4-ton trailer, towed by either a truck, APC or the M9 Armored Combat Earthmover. The dispenser unit has two magazines with a capacity of 400 mines each. The entire procurement of 68 M128 GEMMS units has been fielded, with the initial basis of issue planned to be one per combat engineer company in each Corps

engineer battalion, heavy division, armored cavalry regiment and separate mechanized and armored brigade. However, the GEMMS have only been fielded to USAREUR, the 9th Infantry Division and Fort Leonard Wood as it is a transitional system until the Ground Volcano is fielded.

M138 FLIPPER

The FLIPPER is a manually fed dispenser, operated by one soldier, that will dispense the Ground Emplaced Mine Scattering System (GEMMS) mines at a minimum rate of one mine every ten seconds. The dispenser weighs 110 lbs, and can be attached to the M113 APC, the M548 Tracked Ammo Transporter, the Commercial Utility Cargo vehicle (CUCV) the HMMMV and both the 2 1/2 and the 5 Ton Dump/Cargo trucks. Currently 175 are in production and the basis of issue has not yet been determined. This system has great potential for the emplacement of mines rapidly anywhere behind the FLOT and/or along the flanks and may be of particularly high value to the base cluster defenses of CSS units.

Both the GEMMS and the FLIPPER are designed to emplace large minefields in depth. However, the systems are too slow and too vulnerable to employ within direct fire range of the FLOT when contact is imminent. The major advantage of the system is the rate by which conventional minefields can be emplaced over that of hand-emplaced minefields. Proper use of these systems will allow the preparation of obstacle belts in depth for the close battle.

VOLCANO

The VOLCANO SYSTEM will be configured as both a heliborne and ground

emplaced mine system, replacing the aging M56 system. The XM139 mine dispenser will be mounted on both UH-60 helicopters and a variety of ground vehicles. The dispenser racks accept and launch mines from the XM87 mine canisters which contain five GATOR AT mines and one AP mine per canister. The dispensers hold up to 160 canisters, for a total of 960 mines per load. Slated to replace GEMMS, the basis of issue for ground VOLCANO will be two per combat engineer company. The most rapid of all Army delivery systems, emplacement time for two 1000m x 40m minefields is ten minutes.

RAAMS/ADAM

RAAMS (Remote Anti-Armor Mine System) and ADAM (Area Denial Artillery Munition) are 155mm howitzer shells containing nine AT and 36 AP mines, respectively. These mines can be delivered at ranges from 4 to 17.6 kilometers from the battery position using either the M109 series or M198 series howitzers.

GATOR

The GATOR system is a fully fielded, aircraft delivered scatterable mine system, using the F-4, F-16, F-111 or A-10 Air Force aircraft and the A-6, A-7, F-4 and F/A-18 Naval aircraft. Each Air Force aircraft is capable of delivering six SUU-66 bomblet dispensers for a total of 432 AT and 132 AP mines, while the Navy Aircraft, using the MK-7 dispenser, can drop 180 AT and 90 AP mines. For planning purposes, the minefields emplaced are 650m x 200m. A consolidation of this information is found in Appendix A.

The capability to emplace large numbers of mines with a variety of weapons

systems constitutes an immense saving in both time and manpower. For example, a 1000 x 100 minefield, hand emplaced, takes an engineer company 4.5 hours, 14 tons of materials and 1348 mines. The same minefield can be emplaced with far less manpower in under one hour using GEMMS.[3] The flexibility inherent in such systems is incomparable with conventional ground systems of the past. Mine warfare, once thought of in terms of static, linear obstacles requiring days of planning and preparation, is now a dynamic and flexible tool for the maneuver commander. Yet, a close examination of the numerous delivery systems indicates a dangerous shortcoming in the mine warfare system. Each of these systems is designed for specific purposes and points on the battlefield and the "triad" of delivery systems lacks redundancy and interchangeability. Should a particular system be unavailable or eliminated, the other systems lack the essential characteristics to totally relieve or replace the absent system. Regardless of future developments, ground systems such as GEMMS, Ground Volcano and Flipper are unable to lay minefields forward of the FLOT, air systems are too imprecise to lay minefields within direct fire range of friendly positions and artillery systems are incapable of ranging beyond 25 km. This shortcoming will not vanish in the near future. Development of third generation mine technology focuses on mine capabilities, not advanced delivery systems. The only new delivery system being contemplated-- MLRS and ATACMS delivery of mines-- shares the same shortcomings as air and artillery systems. They are inaccurate and unsuitable near friendly positions.

THE REVOLUTION IN LAND MINE DOCTRINE

The revolution in mine technology has brought about a corresponding revolution in mine warfare doctrine. The revolution centers around the capability to lay minefields in the depths of the battlefield, well forward and to the rear of the FLOT. The goal of land mine warfare remains the fixing, delaying, disrupting and canalizing of enemy forces. The revolution in mine technology and delivery systems means that this goal is no longer constrained to the immediate front of the FLOT; depth and flexibility have been added to both the defense and offense. A dramatic change that essentially redefines the formerly static nature of mine warfare, the TRADOC Operational Concept recognize that:

> "While mines are most effective when used in conjunction with friendly fires, they are also effective when covered by visual or electronic observation and indirect fire. Mines also achieve results when employed without observation or fire.[4]

This has dramatic implications for both the defense and offense. In the defense, it implies that the delivery systems allow for the use of mines in all phases of the deep and the close battle. Some of the most recent developments in mine technology-- the WAM or Wide Area Mine-- allow for mines to be used in an interdiction role, deep in the enemy rear, to assist in the J-SAK (Joint Attack of the Second Echelon) mission to "...divert, disrupt, delay and destroy the enemy's capability for continuous operations."[5] Taken to an extreme, it allows for the use of existing FASCAM in an operational deterrent role, attacking well into the depths of

the enemy's follow-on echelons, beyond the range of most sensor systems. LTC Price Bingham, in "NATO Needs a New Air Interdiction Approach" argues for the use of a FASCAM barrier along the width of the West German border to "...quickly erect minefield (barriers) along Warsaw Pact routes of advance while simultaneously destroying key bridges and other lines of communications infrastructure...giving NATO land forces more time to deploy."[6] John Rybicki, a respected analyst in the field of land mine warfare systems, echoes this theory in "Land Mine Warfare and Conventional Deterrence." While it is beyond the scope of this study to defend or refute the use of scatterable mines as a tool in conventional deterrence, it is worth pondering Rybicki's philosophy of FASCAM in a deterrent role when he states:

> "Minefields employed in approximately three belts from 500 meters to one kilometer in depth from the border could seriously delay the Soviet crossing, keep the maneuver commander cautious and allow the defending forces valuable time to react both offensively and defensively...When the enemy does break through this initial series of obstacles, a new series of mines which can be emplaced dynamically (FASCAM) awaits the attacking force...the US FASCAM systems have created a mining potential which is totally compatible with...US AirLand Battle Doctrine."[7]

Closer towards the FLOT, the Operational Concept implies that the Field Artillery and some army aviation assets can begin the mission of delaying, disrupting and canalizing the enemy well before he comes into effective range of our direct fire systems. Upon breaching the close-in obstacle systems, the delivery systems allow for prompt reseeding of obstacles at the very time that the enemy believes that the breach is successful. Further, the responsiveness of the delivery

systems implies that, should a breach or an assault from an unguarded flank occur, these delivery systems could rain down a shower of AT and AP mines upon an unsuspecting enemy, augmenting and enhancing the effects of other fires.

In the offense, scatterable mines protect the flanks of maneuver units, isolate objectives, disrupt enemy movement within objective areas and disrupt retrograde operations. After an objective is secured, mines disrupt counterattacking enemy forces and provides an immediate barrier between friendly forces and the enemy. Undertaking roles that in the past were performed less effectively by indirect fires and air strikes, the ability to close-off or partition the battlefield from reinforcing enemy forces is a mission ideally suited to short duration minefields.

It is useful to discuss the potential roles for landmines in the offense and defense, and recognize which of those roles became feasible only upon the advent of scatterable minefields.

SCATTERABLE MINES IN THE DEFENSE

In the defense, mines play an important role in every phase of the deep, close and rear battle. For the purpose of demonstrating the use of scatterable mines in the defense, the TRADOC System Manager for Mine Warfare Systems has developed 3 notional scenarios in the Handbook of Employment Concepts for Mine Warfare Systems. They include:

1. A European Standard Warning Countermobility Scenario which envisions the use of a "...complete array of countermobility (assets) to

stop the enemy attack and facilitate a friendly counterattack"

2. A Contingency Area FASCAM Scenario, which involves a US Brigade in a defensive situation with minimum time to prepare for an enemy attack. The scenario begins after hostilities have been initiated and involves the placement of scatterable mines and one obstacle...This is also a countermobility mission, since an obstacle system comprised of mines and a man-made anti-tank ditch is used

3. A NATO Military Operation in Urban Terrain (MOUT) Scenario, in which U.S. forces will defend along a line of small towns and villages. The US forces have the mission to stop and repel the attacking forces and be prepared to counterattack.

For the purposes of replicating the types of missions that are most often studied in service schools and on staffs, as well as to illustrate a "mine intensive" operation, Scenario Two is included in Appendix B. The diagrams in the scenario illustrate the employment and execution of a contingency operation with a variety of systems available to the Brigade Commander. Typical of what a U.S. commander might have available to his force, the delivery systems include:

Ground Dispensers: The equivalent scatterable mine dispensing assets from four combat engineer companies, three of which are equipped with GEMMS and one with the Ground Volcano system.

Air Dispensers: Two Air Volcano dispenser systems mounted on UH-60 Blackhawks: four M-56 mine dispensing systems mounted on UH-1 Hueys and three Air Force A-10s with Gator mine dispensers on call.

Artillery Delivery Systems: One eight tube 155mm howitzer battery capable of firing ADAM and RAAMS fire missions.

Class V scatterable Mines: MOPMS and WASPM

The maneuver commander's concept of the operation is to create a linear obstacle system at the maximum effective range of friendly main battle tanks to stop

the enemy advance. This scenario uses numerous mine systems in the depths of the defense. The full range of engineer assets are employed in the obstacle plan. Field artillery and support assets such as Tac Air support and army helicopters are responsible for emplacing a significant portion of the minefields forward of the FLOT. The overall obstacle effort, well coordinated and executed, is responsible for degrading, delaying and disrupting vast amounts of combat power before the enemy comes into direct fire range of friendly positions.

The scenario demonstrated many, but not all of the missions for scatterable minefields as well as missions that the artillery could be called on to perform should air and engineer assets be unavailable, to include:

Closing gaps and lanes in other obstacles
Reinforcing breached obstacles
Delaying attacking forces to permit additional defensive preparations
Delaying follow-on forces to manage enemy "presentation rates"
Denying enemy use of specific terrain
Channelizing enemy forces into engagement area
Disrupting and harassing enemy command and control
Neutralizing enemy artillery in concert with other counterbattery fires

The timeliness, responsiveness, availability and security of the artillery to perform such minefield missions in concert with, or in the absence of, air and engineer assets, demonstrates the value of the artillery as an integral component of the modern mine warfare system.

SCATTERABLE MINES IN THE OFFENSE

The use of mines in offensive operations was virtually nonexistent before the development of scatterable and remotely delivered mines. The ability to emplace mines along likely counterattack routes or to the flanks of attacking forces was possible in the wake of attacking forces, yet the remotely delivered mine and mobile scattering systems such as GEMMS now allows the commander to do this concurrently with, or in advance of the offensive. Such a capability has dramatic implications for the offense. The commander, formerly concerned with depletion of his forces through requisite tasks such as flank and LOC security, now has the capability to retain far more of his forces at the "tip of the arrow" by a judicious use of minefields in the place of manpower. The use of minefields in the offense allows commanders to control forward, lateral and rearward movement of his and opposing forces on the battlefield.[8]

The use of land mine systems in the offense includes but is not limited to the following missions: [9]

Protecting Flanks. The entire Family of Scatterable Mines (FASCAM) can be use by the maneuver commander in flank protection. This could include supplementing flank reconnaisance and security forces protecting flanks along avenues of approach as well as suppressing and disrupting enemy security elements once contact has been made.[10]

Blocking Counterattack Routes. Mines play an important role in providing

security against potential counterattack routes. Recognizing the attacking forces's weakened condition upon reaching the objective, the maneuver commander may choose to augment his combat power by delivering scatterable mines on potential counterattack routes. Formerly done by hand emplacement, the use of artillery scatterable mines augments and increases the number of mines available to the commander while allowing the use of manpower for other missions.

Contain Enemy Forces and Block Exit Routes. Mines have the capability of isolating an objective and assisting in the defeat of the enemy in detail. On locating the enemy in a defensive position, the maneuver commander can use artillery and air force delivered mines to cut off his routes of retreat, his lines of communication and his reinforcements. Once the enemy is isolated, the attacker can concentrate the bulk of his combat power on defeating him.

Fix and Hold Enemy By-passed Units. One of the essential characteristics of the AirLand Battle offensive is speed. FM 100-5 demands that

> "The attack must move rapidly. Speed is absolutely essential to success; it promotes surprise, keeps the enemy off balance...The attacker tries to carry the battle deep into the enemy rear to break down the enemy's defenses before he can react."[11]

Inevitably, such an operation must envision bypassing enemy pockets of resistance along the way. Such pockets, isolated from support and/or routes of withdrawal through the use of scatterable mines and containment forces, will present little danger to the advancing troops.

Interdict Enemy Rear Areas and Artillery Positions. The value of artillery delivered scatterable mines against enemy rear areas cannot be overstated. Although traditional obstacle doctrine requires that obstacles and minefields be covered with direct fire or observed indirect fire, the use of remotely delivered mines against enemy rear areas brings this restriction into question. The use of scatterable mines attacks one of the advantages of the defender-- the ability to "...surprise his opponent constantly throughout the engagement by the strength and direction of his counterattacks."[12] Recognizing that the attacker has the initiative to attack at the place and time of his choosing, the defender must be able to concentrate his forces in response to the attacker's initiatives. An attacking maneuver commander with responsive intelligence and fire support assets can effectively neutralize selected counterattack threats by interdicting these forces directly with AT, AP and (soon) Anti-helicopter minefields, or upon the routes from which the defenders intends to reinforce or counterattack. Such minefields, in cooperation with other interdiction assets such as BAI and indirect fires, requires the defender to conduct extensive breaching operations under fire before coming to battle. Previous to the development of scatterable and remotely delivered mines, this "isolation by fire" was only marginally effective. With the ability to remotely deliver minefields, the maneuver commander is now capable of isolating counterattack forces for much longer periods of time, and with far fewer assets than before.

Disruption of a Meeting Engagement. Although not discussed in current literature, the ability to disrupt an enemy developing the situation in a meeting

engagement is a tremendous advantage to the commander. The Soviets practice methodically seizing the initiative in a meeting engagement. It would be much harder to seize that initiative after delivering scatterable mines in the midst of that meeting engagement. The capability of minefields to prevent follow-on forces from reinforcing the detachments in contact, isolating the enemy into readily defeated "chunks" of combat power, may take from the Soviets one of their espoused tactical advantages-- the ability to prevail in a meeting engagement. It must be noted, however, that the use of scatterable and remotely delivered mines in a fluid situation such as a meeting engagement is fraught with peril. Maneuver and flexibility can be taken away from both sides when scatterable mines are used, and the potential for fratricide is high.

In conclusion, the use of scatterable and remotely delivered minefields is a major tactical innovation and advantage for both the defender and the attacker. For the defender, it allows the destruction of enemy combat power to begin well forward of friendly defensive positions, as well as facilitating the process of shaping the battlefield. In direct contact, the ability to deliver minefields dynamically throughout the length and breadth of the engagement by reseeding existing obstacles, isolating unprotected flanks and creating new obstacles on top of the attacking enemy adds a significant degree of flexibility to the defending commander. In the offense, the use of minefields grants the maneuver commander a dimension of agility once only imagined. Mines can protect the flanks of the maneuver unit, isolate objectives, disrupt enemy movements and disturb retrograde operations.

These critical missions, once requiring the use of forces and fires, can now be accomplished quickly and efficiently using dynamically delivered mines. In doing so, the commander can conserve his maneuver forces so that they are deployed at the most critical position on the battlefield-- the "tip of the arrow."

TROUBLE IN PARADISE

The mine warfare system, viewed in isolation, is one of sophistication and intelligent planning, providing a layered system of Anti-Tank and Anti-Personnel minefields throughout the extent of the battlefield. When properly executed, it has the potential for accomplishing a unique duality on the modern battlefield. The principle of mass envisions two aspects-- the concentration of superior combat power in space and time. Yet, modern weapon systems which deny one's adversary the ability to mass are designed to destroy combat power, or prevent its concentration in space and time, but not both. The modern mine warfare system is unique in that it can destroy combat power and deny him the ability to concentrate in space and time. The destruction of combat power is illustrated historically by the vast casualties taken by armored vehicles and personnel from mines. The future portends well for the capability of modern mine warfare systems to prevent the concentration of that combat power in space and time. In 1979, GEN Starry, then commander of TRADOC, reinforced this concept when recognizing that:

"..offensively and defensively, enemy second echelons could be cheaply deprived of their essential capabilities of mass, momentum and mobility by the intelligent use of barrier warfare, artillery delivered scatterable mines and DPICM."[13]

NATO plans for intelligent use of these assets well before the Warsaw Pact closes into the Main Battle Area. Striking deep in the enemy rear, air interdiction with Gator-armed fighters can delay and deny enemy forces into the Corps commander's area of responsibility. As the enemy approaches this area, the Corps commander has additional interdiction assets such as Lance, MLRS and EW capable of attriting enemy forces. As the enemy closes on friendly positions, artillery fired RAAMS and ADAM from 155mm howitzers and helicopter emplaced Volcano continue the delay, denial and destruction of enemy forces. Upon entering the range of friendly direct-fire systems, GEMMS, Ground Volcano, MOPMS and conventional minefields complete the gauntlet that the enemy must run. His forces, diminished and disorganized, must go into battle well after any planned time schedules, separated from any coordinated action by forces on his flanks, and possibly along less-preferred avenues of approach. It remains only for friendly forces in the main battle area to finalize the destruction of the enemy through aggressive close combat. Existing NATO OPLANS envision the capability of the modern mine warfare system to:

"...cause significant enemy delay, degrading enemy potential and contributing to a high anti-armor kill rate along the NATO front..this potential, if exploited, could provide more time for deploying U.S. combat forces and mobilizing other NATO resources; and that FASCAM could provide a "combat multiplier" at relatively low cost when compared to other means for delivering similar results"[14]

Unfortunately, the scenario envisioned views the mine warfare system and the mine delivery assets in isolation. It is a scenario predicated on unrestricted use of air, artillery and engineers assets to deliver mines at the time, place and in the quantity desired by the maneuver commander. However, each of these mine-capable organizations has additional-- and possibly more critical-- roles. Mine warfare will be just one of several competing tasks in the battle. Gator delivery by the Air Force will have to compete with close air, battlefield air interdiction and offensive counter-air tasks supporting the commander's scheme of maneuver. Army aviation assets, already burdened with troop transport and logistic resupply missions, will be further encumbered by mine scattering missions. The engineers have a variety of battlefield tasks, including mobility and survivability missions which will compete with minefield emplacement missions. Although the engineer's possess systems exclusively dedicated to mine delivery, the personnel manning that equipment can be tasked for a variety of other engineering missions.

Relying upon the Field Artillery to provide the assets to overcome these shortcomings is equally specious. The maneuver commander may be forced into accepting a Hobson's choice- relying on less than optimum concentrations of minefields, or making greater demands on his supporting artillery. In either case the artillery assumes a greater significance in the mine warfare system than an isolated view might envision. Given high levels of enemy air defense capability, air assets will limit their missions to the bare minimum. Any level of enemy activity along the FLOT may make the use of GEMMS undesirable. Lacking sufficient support from

two legs of the mine warfare triad, the artillery-- potentially the most effective and responsive minelaying system in the Army's inventory-- may become the primary system for mine delivery, perhaps by default.[15]

Simulations conducted in 1979 confirm this overreliance on artillery. The Engineer Studies Center analysis of minefields determined the following FASCAM requirements: 10% for ADAM/RAAMS, 75% for GEMMS and 15% for MOPMS. However, AMMORATES P-86E data developed at that same time indicated a need for 87% ADAM/RAAMS, 5% GEMMS and 8% MOPMS. Further, 1979 expectations were that by 1986 more than 85% of Army FASCAM assets planned for procurement would be for ADAM and RAAMS.[16] While the studies may be criticized for their age and the absence of recent developments such as VOLCANO, they illustrate a tendency, still present today, to depend on the Field Artillery to overcome shortfalls in the other mine delivery systems. Yet, an imprudent dependence upon the Field Artillery to play the principal role in mine warfare delivery would be a fatal flaw in mine warfare doctrine.

THE SHORTCOMINGS OF ARTILLERY MINE SYSTEMS

The first shortcoming of the artillery mine delivery system has already been mentioned. The multiple roles of the artillery, like the other legs of the triad, potentially crowd out or severely restrict the capability of the artillery to perform minelaying missions. Every howitzer delivering mines is one less howitzer

performing traditional artillery missions. Were mine delivery the only new mission tasked to the artillery, the problem would be surmountable. But, mine delivery is only one of many new missions tasked to the artillery in recent years. The development of Copperhead and DPICM to destroy tanks, laser designators to direct precision-guided munitions and advanced fire control systems to manage the entire fire support system on the battlefield are a few of the innovations under the responsibility of the Field Artillery. The addition of JAAT, SEAD, nuclear and chemical missions, and the expectation for proponency over SADARM (Search-and Destroy Armor) munitions while still maintaining responsibility to provide conventional maneuver fire support and counterfires means that the Field Artillery, extended on previous battlefields, will be asked to do even more on the modern battlefield. As Peter Williams states in "The Role of Artillery- the Impact of Autonomous Precision Munitions,

> "The role of artillery will be dramatically extended to embrace a new range of targets. But it is generally agreed that NATO artillery will already be overstretched against massed attacks, so how can they take on so many extra targets? The answer is they cannot...(and) more artillery will be needed."[17]

This problem can be mitigated during defensive operations. A minimum of preparation time should allow artillery emplacement of scatterable minefields as part of the overall obstacle plan, preferably before the enemy comes into direct fire range. The artillery may be involved in harassing and interdiction fires during this

period, but rarely will the majority of artillery assets be so engaged that minelaying missions will be crowded out. Minefield targets of opportunity, however, may suffer from the need to provide other forms of defensive fire support. The development of "packaged" target of opportunity minefields, consisting of 24 RAAM and six ADAM rounds, providing a 400 X 400 minefield of .001 density, should ensure that the maneuver commander has a highly responsive, albeit limited on-call minefield capability throughout the battle.

In offensive operations, however, artillery minelaying will be competing with a profusion of other fire support missions at the very time when minelaying is most needed. Displacement, preparation, suppressive fire, obscuration, counterbattery and interdiction missions may take higher priority during offensive operations, thus limiting artillery minelaying missions. GEMMS, and to a large degree other engineer assets are unresponsive during offensive operations. Aviation assets must perform other high priority missions. The lack of capability may indicate an overall lack of responsiveness of the mine warfare system during offensive operations. In general, higher priority missions, lack of assets and conflicting priorities may crowd out minelaying missions across all mine delivery systems-- not just the field artillery.

A second shortcoming of artillery delivered minefields is the exposure of the artillery to enemy counterbattery fires during mine delivery. Rarely discussed, the peculiarity of the ADAM/RAAM mission threatens the security of the firing unit far more than a conventional fire mission. The problem is twofold.

First, to ensure an evenly patterned 400 X 400 minefield, the howitzers

typically fired at a high angle of elevation. While reducing the number of aimpoints that the battery must fire and, hence, the overall mission time, this dangerously exposes the howitzers to counterfires. A high trajectory is far easier to detect by countermortar and counterbattery radars. Should the mission be fired at a low angle, the rounds would disperse less symmetrically, and the requirement for more aimpoints would increase the overall mission time.

Second, the lengthy mission time gives enemy countermortar and counterbattery radars far more opportunity to acquire the artillery location than a normal artillery fire mission, and forces the firing unit to remain in position for extended time periods. Should TACFIRE assign the mission to a platoon of four howitzers, it would take approximately eight minutes to fire the mission, with a sustained rate of fire of one round per minute. Firing high angle, this is more than enough time for a location to be vectored by counterbattery assets. At best, this requires a displacement immediately after the mission and the loss of artillery support assets during critical phases of the battle. At worst, it means the destruction of those assets. Given that a maneuver brigade commander can expect perhaps two battalions supporting his forces, losing one firing platoon of twelve is a high price for the injudicious use of artillery fire support assets.

A third shortcoming of artillery delivered mines is the high price paid by the artillery basic load. Ammunition logistics is a problem that transcends the issue of artillery mines, but the inclusion of ADAM and RAAMS in the basic load further illustrates and exacerbates that problem. Today, the artillery battalion is being

asked to do far more in a high intensity environment than its logistics capability is capable of supporting. In his recent article, "Field Artillery Ammunition Resupply Solution," Dr. Robert A. Kromer detailed the problem of insufficient ammunition for the 155mm howitzer in a high intensity environment. Using current estimates, each howitzer in an artillery battalion may be required to fire the following rounds per tube per day:

Current Howitzer Ammunition Requirements:

Type of operation (Heavy commitment)	Rounds per Tube per Day (RTD)
Covering Force	274
Defense of Position	207
Attack of Position	153

Given the current ammunition hauling capabilities of the field artillery battalion, these expenditure rates present long run sustainment difficulties if any loss of hauling capacity occurs. Further, Dr. Kromer points out the problem gets worse. His analysis of projected expenditures in future scenarios is shown below:

Future Howitzer Ammunition Requirements:

Type of Operation	RTD (HIP How)	RTD (AFAS-C How)
Committed	201	473
Surge	387	911
Peak	599	1409

Although the purpose of his study was to illustrate the logistical shortcomings of anticipated howitzer developments, it further highlighted the overall problem of ammunition resupply on the high intensity battlefield. The recent development of Copperhead, Dual-Purpose ICM, Rocket-Assisted projectiles and ADAM/RAAMS, and anticipating the development of artillery delivered SADARM munitions, the field artillery community is wrestling with the problem of optimal basic loads. As Dr. Kromer states,

> "While these munitions provide the means to accomplish certain missions better, they pose significant problems. With the exception of DPICM, SADARM and High Explosive ammunition, artillery munitions used in Field Artillery School combat simulation models are projected to be used infrequently."[18]

Such a belief could crowd ADAM and RAAMS out of the basic load entirely. Given a prioritization of artillery assets to missions requiring HE, DPICM and SADARM, and constrained by ammunition carrying capabilities, the maneuver commander may be forced to forgo the use of ADAM and RAAMS in order to ensure that he is sufficiently supported with higher-priority ammunition.

A fourth shortcoming is the ponderous and questionable command and control system developed for artillery delivered minefields. According to the Operational Concept, there are at least three agencies involved in the planning, coordination and execution of artillery minefields. The maneuver commander "...designates areas of operations in which subordinate commanders can use mines...(and) also direct emplacement of mines within a subordinate commander's area of operation to support..obstacle plans."[19] Combat engineers are the maneuver commander's primary source of mine warfare advice, assistance and capability.[20] Field Artillery ".. and other designated commanders emplace scatterable mines using organic delivery systems,"[21] and artillery Fire Support Officers are responsible for their integration and execution in the scheme of maneuver.

When an artillery delivered minefield is pre-planned, the system is quite specific about the steps involved in coordination. The engineer and FSCOORD work together to ensure that the artillery mines are in harmony with the remainder of the obstacle plan, and that the planned minefields are recorded on appropriate operations maps. Although the process involves numerous agencies, the coordination is effective given sufficient time to inform all concerned parties.

The use of minefields against targets of opportunity, however, skips a number of the coordination agencies and potentially exposes the force to risk. Although the capability for on-call minefields is one of the greatest assets to the maneuver commander, the target of opportunity may be a two-edged sword. In order to ensure responsiveness, an on-call minefield becomes, in effect, another artillery fire

mission. The engineer is eliminated from the approval chain and the system is dependent on the field artillery coordination channels to ensure that higher, lower and adjacent units are informed of their use. The potential for fratricide is immense, and anecdotal evidence from the National Training Center is replete with such fratricide. The paradox is that for preplanned minefields, the coordination involved is perhaps too ponderous, while for on-call minefields the system is too unpredictable. In either case, the command and control system surrounding the use of artillery delivered minefields is questionable in light of the need for agility and synchronization on the AirLand battlefield. The development of command detonation features in the future may eliminate this problem, but until that time the system demonstrates more than enough shortcomings to warrant stiff restrictions on their employment, especially against targets of opportunity. However, the final decision, as always, must be left to the maneuver commander.

The final shortcoming of artillery delivered mines is perhaps the most damning-- artillery delivered mines just aren't that good. There are several criticisms; artillery delivered mines are easy to detect and counter, they are delivered in low densities and they have a high parasitic weight.

The type of mine used in the RAAMS is known as a Miznay-Shardin plate mine which forms a self-forging slug upon activation. While it can attack a target over the full width of the target, it is

> "..far more effective under a vehicle's belly when it is given an opportunity to fully form its Miznay-Shardin plate than when it is contained under a vehicle track...For this reason, the full effect of a (Miznay-Shardin) mine that detonates directly under a tank track is not

completely felt and...the effects are only those of the amount of explosive within the mine. "[22]

The consequences of this are profound. A Miznay-Shardin mine which is given the proper amount of offset between the mine and the target forms a self-forging slug which penetrates and causes spalling of the belly armor of a tank. If that same mine is run over by a track, the slug is not formed and damage is only caused by the 3.8 pounds of reacting explosives. In essence, the mine has a low probability of a mobility kill, and a high probability of a system kill. Unfortunately, the scatterable nature of the RAAMS mine system means that we have no choice in how or where the mine will land after it is ejected from the howitzer round. If the commander intends to interdict a high speed avenue of approach such as a road, this means that such mines on a road or roadbed can be easily swept away after the first is detected. Immediate reaction drills for armored vehicles might demand the vehicle simply run over the mines and risk a low probability maneuver kill, or use onboard machine guns to activate their anti-handling devices.

To add to this shortcoming, the sensor on a RAAMS mine is a magnetic influence fuse. While this is a great advantage in ensuring that the mine will detonate only underneath the vehicle where the magnetic signature is uniform (and the belly is underprotected), it leaves the fuse highly susceptible to electronic countermeasures. The magnetic signature of the tank "...could rather easily be simulated by a forward- and downward-looking device mounted on the hull front, which would detonate the mine harmlessly in front of the vehicle." [23]

In fact, one of the projects under development in the U.S. Army is the Vehicle Magnetic Signature Duplicator, designed to defeat magnetic influence fuzed mines.[24] This compact, vehicle mounted equipment consists of an electro-magnetic coil and electronics module, feeding off the vehicles electrical generator. Magnetic influence fuzes are deceived by this false image and detonate five to six meters in front of the vehicle.[25] Mounted on the lead tanks or vehicles of an armored column, such devices could effectively preclude any damage upon a moving force.

Further detracting from the effectiveness of the artillery delivered minefield is the high "parasitic" weight of the rounds.[26] In a high intensity environment as is anticipated in Western Europe, the hauling capability of the logistics system will be sorely pressed. The heavy weight of the howitzer round (153 lbs. with packing material) must be justified by its effectiveness. The delivery of a prepackaged minefield of 24 RAAMS and 9 ADAM, weighing 5049 lbs, is a heavy logistics burden for the delivery of 216 3.8 lb anti-tank mines. By way of contrast, the heliborne VOLCANO system is capable of laying 800 similar anti-tank mines in one lift and avoiding many of the safety problems inherent in artillery delivery.

Finally, the high weight and small size of the RAAMS howitzer shell add up to another shortcoming of artillery delivered minefields-- their low minefield densities. In an attempt to arm the maneuver commander with a responsive, deep and flexible mine warfare system, the system sacrificed one of the foundations of effective mine warfare-- high densities of mines along likely enemy approaches. While the benchmark for mine warfare systems continues to be a linear density of one mine

benchmark for mine warfare systems continues to be a linear density of one mine per meter of front, (a density questioned by the Soviets in Afghanistan) the following are the area and linear density of representative minefield norms:

Delivery System	Area Density (mine/sq m)	Density as a multiple of RAAMS	Linear Density (mine/m)	Density as a multiple of RAAMS
Artillery	.0014		.54	
M-56 (UH-1)	.0100	7.4x	.20	.37x
VOLCANO (UH-60)	.0075	5.5x	.80	1.48x
GATOR	.0033	2.5x	.66	1.23x
GEMMS	.0042	3.1x	.75	1.39x
M-15 (Hand)	.0200	14.8x	1.00	1.85x

Although these numbers are not as alarming as one might suppose, when the safety zone of RAAMS is taken in to account, the actual density is further reduced. An exact figure is impossible to determine, as the distribution of the mines within the 400 x 400 minefield and the 1000 x 1000 safety box surrounding it is not symmetric. However, if one assumed that 80% of the AT mines fell into the 400 x 400 minefield, then the adjusted linear densities would be:

	Linear Density (mine/m)	Density as a multiple of RAAMS
RAAMS		.43
M-56 (UH-1)	.20	.46x
VOLCANO	.80	1.86x
GATOR	.66	1.52x
GEMMS	.75	1.74x
M-15 (Hand)	1.00	2.32x

It is interesting to note that while the U.S. Army continues to use one mine per meter of front, recent unclassified reports of Soviet engagements in Afghanistan indicate that for scatterable anti-personnel mines densities as high as 4000 mines per kilometer have been reported.[27]

Further, the indiscriminate patterning of the artillery munitions means that the density per meter of critical terrain will be lower. In the scattering of mines by all systems save for the artillery, the delivery can be modified throughout the scattering process. Obvious routes, avenues and lanes can be weighted heavier with mines than less negotiable terrain. Even Air Force aircraft, flying at high rates of speed, are able to apply some measure of discretion to the minefield site. ˋrtillery delivery, in contrast, carries with it the burden of random patterning. Once the area is identified by a ground observer, the scattering pattern of the mines is fixed. While the observer has some discretion on the position of the aimpoints, the dimensions of the minefield have few variations, and the ability to cluster mines in high densities around certain high-payoff areas is extremely limited when compared to the other delivery systems.

Even more precarious is the shortcoming inherent in all scatterable mines, their surface scattering. FASCAM mines, because they are surface scattered, are easier to detect than conventional mines. This is especially critical when FASCAM is used in interdiction missions because hard and irregular surfaces may be encountered. Tests have been conducted specifically addressing the detection and avoidance of scatterable mines. They found that vehicle speed, minefield density and

low (buried) and high (scatterable) detectibility parameters contributed to the detection and avoidance of the mines. The tests, albeit conducted in desert terrain, found a significant difference in detection rates for buried and scatterable mines.[28]

SUMMARY

The use of artillery as the key element in the mine warfare system is a questionable proposition. The low number of artillery battalions in the current army organization, the vastly increased number of missions the modern artillery system performs, the dubious control system which manages minefield emplacement and the questionable value of the mines used in the RAAMS should give little comfort to the maneuver commander depending on this system.

However, to walk away from the problem at this point, suggesting that the system is inadequate and imperfect would ignore a fundamental truth. Should the U.S. Army go to war tomorrow, it will go with the forces and equipment on hand. To wait for future developments such as the Wide Area Mine, MLRS delivery or SADARM technology ignores the needs of forces-in-being. The problem must be resolved. Yet, two problems face any universal doctrine for the employment of field artillery minefields. First, the employment is heavily dependent upon conditions of METT-T (Mission, Enemy, Terrain, Troops and Time Available). Because of this, no universal, unyielding doctrine is possible and the personality of the commander becomes an important issue. Second, and most important, is that a rigid, parochial

approach to the issue usurps a degree of flexibility that the system was designed to provide. The role of the air, engineer and artillery liaison elements in the headquarters is to advise the commander on the best use of his assets. A prescriptive doctrine may change that counsel into mandate.

It is clear that little has been accomplished in the domain of artillery delivered mine doctrine. The Operational Concept provides a strong foundation for the development of such doctrine, and the Corps of Engineers, appointed the Tradoc System Managers for Mine Warfare Systems, have produced a number of outstanding doctrinal publication for scatterable mines in general. The Handbook of Employment Concepts for Mine Warfare Systems, although considering the question in isolation, incorporates the lessons outlined in the Operational Concept, and attempts to put the disparate pieces of air, engineer and artillery together into a cohesive whole. The Field Artillery community, in contrast, has progressed little in detailing a doctrinal vision for their slice of the mine warfare pie since the fielding of ADAMS and RAAMS. TC 6-20-5, Field Artillery Delivered Scatterable Mines provides some overarching principles on employment and responsibilities, but this document simply parrots the axioms found in Engineer Field Manuals. Publications such as the recent TC 6-71, Fire Support Guide for the Maneuver Commander are no better, and cannot substitute for clear, precise guidance.

The true measure of doctrinal development-- open source literature and debate on methods, techniques and procedures-- has been noticeably lacking among the artillery community. If the amount of publication devoted to scatterable mines is

any indicator, the two articles in the Field Artillery Journal since 1979 is a poor record for the development of thought and discussion. In fact, little has been published since then-Major Prehar challenged the artillery community in the Field Artillery Journal by stating "What will dictate the basic load configuration is firm doctrine on the use of artillery scatterable mines. Without this, we assume our way out of reality."[29] Others have failed to rise to the challenge.

It is not the intent of this paper to prescribe doctrine for the employment of artillery delivered mines. Yet, there are a number of unresolved and conflicting issues which must be confronted in order to guide present day fire support personnel in providing the best advice and counsel to their maneuver commanders. Lacking any resolution of these issues, fire support personnel will continue to advise their maneuver counterparts in an ad hoc, highly personalized manner. While the ,one of the following section may drift towards dogmatism, it is in the hope that a direct approach may motivate and challenge the artillery community into questioning, debating and challenging the limited available doctrine surrounding artillery delivered mines. Hence, the following "distilled wisdom" from the scores of authors outside of the artillery community who have have pondered this problem for us-- as well as few novel ideas.

ON THE EMPLOYMENT OF ARTILLERY SCATTERABLE MINES

1. Mine warfare is but one of the instruments available to the maneuver commander in the conduct of operations. As such, METT-T and the maneuver commander's concept of the operation will set the priority for the use of mine warfare systems in any particular operation. As mine delivery systems have multiple uses, METT-T will further determine if a particular operation finds an emphasized or decremented dedication of delivery assets towards mine warfare activities. This is a decision that rests with the maneuver commander, based on the counsel of his engineer, air and artillery liaison elements.

2. Mine delivery systems are a triad of air, artillery and engineer assets. Yet, these systems are only partially interchangeable. Each of the delivery systems has been designed for a particular aspect of mine warfare, and no system is able to completely replace the loss of another. It is incumbent upon fire support personnel to know the entire spectrum of the mine warfare system so as to best advise, in concert with the engineer liaison, the maneuver commander.

3. Artillery delivered minefields are the most flexible and responsive minefields available to the maneuver commander. They are the only system below division level that are capable of delivering mines beyond the FLOT.[30] Under proper conditions, they can be employed anywhere on the battlefield, and are restricted only to the range of the howitzers. As such, they are extremely valuable in both offensive and defensive operations. Examples of missions appropriate for artillery delivery include:

OFFENSE	DEFENSE
-Protecting Flanks	-Closing gaps and lanes
-Blocking counterattack routes	-Reinforcing breached obstacles
-Containing enemy forces	-Delaying attacking forces
-Fixing and holding bypassed units	-Denying specific terrain
-Securing bridge and fording sites	-Channelizing enemy forces
-Interdicting rear areas	-All listed offensive interdiction missions
-Interdicting enemy C3	-Blunting penetrations
-Interdicting enemy fire support	-Counterbattery fires
-Disrupting meeting engagements	
-Counterbattery fires	

4. Artillery delivered minefields are limited by a number of critical shortcomings. Artillery assets will be in great demand on the battlefield, are highly vulnerable to enemy counterfires, and are encumbered by heavy logistical burdens. Maneuver commanders must clearly articulate their scheme of maneuver so that fire support personnel can properly support the operation with <u>all</u> classes of indirect fires, to include RAAMS and ADAM.

5. Artillery delivered minefields are highly responsive, but demand command and control efforts well beyond those of normal minefields and artillery fires. Preplanned minefields must be <u>approved</u> by the engineer liaison element, and disseminated to higher, lower and adjacent units prior to emplacement. On-call minefields must be <u>allocated</u> by higher headquarters to ensure strict control over their use and employment. It is virtually impossible to ensure that all higher, lower

and adjacent units are made aware of "target of opportunity" minefields and the risk of fratricide-- even within short duration minefields-- demands that greater control surround the use of such minefields. Until the development and fielding of command activated minefields, artillery delivered minefields must be allocated to subordinate units, rather than freely dispensed, and commanders one level higher must approve their initiation dynamically, not during the planning process. For artillery delivered minefields positive approval, not consent by silence, must be obtained. Fire support personnel have the responsibility to inform higher, lower and lateral units of the employment, location and duration of on-call scatterable mines through existing MINEWARN message formats.

6. Artillery delivered minefields are dangerous. The absence of positive control on their emplacement, the lack of visual marking systems and the strong chance that all relevant units will not know of their location means that their use must be judicious, if not restricted. Indiscriminate use of such minefields may pose a greater danger to allies than to adversaries.

7. Artillery minefields must not replace planning and foresight. By nature highly responsive and flexible, they have the potential to hide a great number of failures in planning and execution. Yet, this responsiveness is limited. At the very time when they can be the most responsive, artillery assets may be committed to higher priority missions.

8. Artillery delivered minefields should be the last choice of the maneuver commander, not the first. Sufficient allocation of air and engineer assets before the

battle and proper planning to take advantage of the unique characteristics of each delivery system should ensure ample mine warfare capabilities for the force. The major limitations inherent in Field Artillery mine delivery system mandates that "...the ADAM and RAAM system should be selected only when other FASCAM systems are deemed inappropriate."[31]

CONCLUSION

The past ten years has seen a revolution in the field of land mine warfare. The development of second generation mine technology and the widespread advances in mine delivery systems has transformed the vision of mine warfare from one of Infantrymen laboriously digging pits for heavy, awkward mines into a notion of rapid, flexible mine scattering by a plethora of systems anywhere on the battlefield.

Yet, the rapid hardware advances have not been accompanied by commensurate development of principles which take advantage of those advances. While the U. S. Army Training and Doctrine Command has published a thorough Operational Concept for mine warfare and the system managers have developed a handbook of employment concepts, the lowest level of the organization-- the user community-- still relies on an ad hoc, highly personal approach to employment of these technological advances. While the Engineers might be excluded from this harsh assessment, Air Force, Army Aviation and the Field Artillery must certainly be criticized for their lack of consistent and integrated doctrinal literature on the

subject of artillery delivered mines.

The Field Artillery must shoulder a great portion of this burden. Responsible for the coordination of all fire support systems on the battlefield, the majority of the scatterable mine systems are delivered by fire support assets such as cannon, aircraft and, soon, missiles. However, the Field Artillery, increasingly encumbered by additional responsibilities on the battlefield, seems unable to articulate the necessary principles and guidelines. While the appointment of the Corps of Engineers as the proponent agency for mine warfare systems requires the Engineers to develop the doctrine for the entire system, the Field Artillery must still advance doctrine and principles for the artillery portion of that system.

In conclusion, adding the duty of mine delivery to the extensive list of Field Artillery Battlefield tasks complicates the overall task of supporting the maneuver commander's concept of the operation. Many of the problems could be solved by additional artillery battalions, additional command and control apparatus or additional weapon systems which could deliver scatterable mines. Imagine the value of a simple, rugged multiple rocket launcher like the Soviet BM-21 delivering 40 rocket pods of scatterable mines in under 20 seconds. However, it was the intent of this paper to stay within the current limitations of personnel and equipment. Future papers would do well to articulate new requirements of this sort.

While the need for scatterable mines is apparent, the artillery community must be more specific, more detailed and more uniform in its approach to the problem. Artillerymen must be made aware of the advantages as well as the shortcomings

associated with scatterable mines. They must be made aware of the conditions under which scatterable mines best serve the maneuver commander, and those which endanger the force. They must realize the shortcomings of the current control system, the Miznay-Shardin mines and the high logistical burden. Only when these advantages and shortcomings are known, discussed and debated will the user community be fully capable of exploiting artillery delivered mines to their full potential; and only when the artillery community fully articulates their doctrinal vision for the employment of artillery delivered mines will this discussion begin.

1. TRADOC Pamphlet 525-19, U.S. Army Operational Concept for Lane Mine Warfare, (HQ, U.S. Army TRADOC, 1982), forward. Operational Concepts ".. describe how combat, combat support and combat service support operations are to be conducted...used by TRADOC training, organization, doctrine and material developers in their various programs." They are the link between theory and doctrine.

2. Department of Combined Arms. Scatterable Mine Handbook, (United States Army Engineer School, 25 August 1988), pp. 9-23. This description of MOPMS and the following mine systems are the subject of Section II- Systems Characteristics and Planning. This handbook, along with the Handbook of Employment Concepts for Mine Warfare Systems, are the two best sources for the topic of scatterable mines. Not surprisingly, they are publications of the Corps of Engineers.

3. Department of Fire Support and Combined Arms Operations. Battle Book, (U.S. Army Field Artillery School, April 1988), pp. 3-2, 3-3.

4. DA PAM 525-19, Operational Concept, p. 3.

5. TRADOC Pamphlet 525-45, General Operating Procedures for Joint Attack of the Second Echelon (J-SAK), (HQ, USAREDCOM, December 1984), p. 1-1.

6. LTC Price T. Bingham, USAF, "NATO Needs a New Air Interdiction Approach," Armed Forces Journal International (October, 1986), p. 115.

7. John F. Rybicki, "Land Mine Warfare and Conventional Deterrence," NATO's Sixteen Nations (September-October 1984), pp. 77-80.

8. Major Bohdan Prehar, "Artillery Scatterable Mines," Field Artillery Journal (September-October 1979), p. 10. One of the few references to scatterable mines and their employment in the Field Artillery Journal.

9. This section on employment concepts is taken from a number of sources, including; TRADOC System Manager for Mine Warfare Systems, Family of Scatterable Mines, (U.S. Army Engineer Center, 1988), pp. 2, Handbook of Employment Concepts for Mine Warfare Systems, (U.S. Army Engineer Center, 1986), pp. 33-96 and Training Circular 6-20-5, Field Artillery Delivered Scatterable Mines, (HQ, Department of the Army, 8 January 1982), pp. 1-8.

10. TC 6-20-5, Field Artillery Delivered Scatterable Mines, p. 7.

11. Field Manual 100-5, OPERATIONS, (HQ, Department of the Army, May 1986), p. 97.

12. Carl Von Clausewitz, On War, (Princeton, 1976) p. 360.

13. Kishyama, et al., "An Assessment of the Family of Scatterable Mines," p. 22.

14. Ibid, p. 2.

15. Prehar, Artillery Scatterable Mines, p. 10.

16. Kishyama, et.al., "An Assessment of the Family of Scatterable Mines," pp. XIX and 52.

17. Peter Williams, "The Role of Artillery- the impact of Autonomous Precision Munitions," NATO's Sixteen Nations (November 1986), p. 56. As the purpose of this article was to decry the dilemma posed by adding Precision Guided Munitions delivery to the essential tasks list of the artillery, one must wonder what Mr. Williams would say about mine delivery missions.

18. Dr. Robert A. Kromer, "Field Artillery Ammunition Resupply Solutions," Field Artillery Journal (October 1988), p. 17. Although the focus of Dr. Kromer's article is on the logistical shortcomings of present and future artillery systems, this article illuminates the differences in modelling efforts between the various branches. While the Field Artillery models show high requirements for HE, DPICM and SADARM, many other models such as Kishyama, et al. prepared for the Engineer Studies Center emphasize the importance of munitions such as FASCAM.

19. TRADOC PAM 525-19, US Army Operational Concept, p. 8.

20. Ibid, p. 9.

21. Ibid, p. 9.

22. TRADOC System Manager for Mine Warfare Systems, Handbook of Employment Concepts, p. 47

23. Richard E. Simpkin, Antitank, (Exeter, 1982), p. 83.

24. LTG E. R. Heiberg III, "Readiness...preserves peace," The Military Engineer (January-February 1988), p. 19.

25. LTC C.E.E. Sloan, Mine Warfare on Land, (London, 1986), p. 85. An excellent reference on the entire spectrum of land mine warfare. Particularly strong in recent and future developments in conventional and scatterable mines.

26. Kishyama, et al., "An Assessment of the Family of Scatterable Mines," p. .

27. Threat Directorate, U. S. Army Infantry School, "Soviet Landmine Operations, Part II," Infantry (July-August 1988), p. 25.

28. Kishiyama, et al., "An Assessment of the Family of Scatterable Mines," p. 18.

29. Prehar, "Artillery Scatterable Mines," p.11.

30. TRADOC System Manger for Mine Warfare Systems, Scatterable Mine Handbook, p. 18.

31. Kishyama, et al., "An Assessment of the Family of Scatterable Mines," p. B-5.

Appendix A: Mines and Mine Dispensing Systems' Characteristics

CONVENTIONAL MINES

	Mines	Present Status	Arming	Fuzing	Warhead	Sensing Width	Anti-Handling Device	Self Destruct	Explosive Weight	Mine Weight	Mines Per 5 Ton Dump	Remarks
AT	M-15	Fielded	Manual	Pressure	Blast	Track	Yes	No	22 Lb.	30 Lb	90	Fuze being upgraded with a tilt rod. Last procured FY52
	M-19	Fielded	Manual	Pressure	Blast	Track	Yes	No	21 Lb.	28 Lb.	196	Last procured FY58
	M-21	Fielded	Manual	Tilt rod	Shape charge	Vehicle	Yes	No	11 Lb.	17 Lb.	192	Last procured FY62
	M-24	Fielded	Manual	Tape strip	3.5" rocket	10 meters	Yes	No	18 Lb.	18 Lb.	1,440	3.5" rocket
	ICOMS	Conceptual	Manual	Various	M-S plate	Vehicle	Yes	No	3-4 Lb.	6-8 Lb.		To replace M-15, M-19, M-21, AT Mines
AP	M-14	Fielded	Manual	Pressure	Blast	Point	No	No	1 Oz.	3.3 Oz.	6,480	Last Procured FY74
	M-16A1	Fielded	Manual	Pressure Tripwire	Bounding	Point	Yes	No	1 Lb.	8 Lb.	672	Primary AP mine
	M-18A1 (Claymore)	Fielded	Manual	Command	Directional Fragmentation		No	No	1.5 Lb	3.5 Lb	1,782	

SCATTERABLE MINES

	Mines	Present Status	Arming	Fuzing	Warhead	Sensing Width	Anti-Handling Device	Self Destruct	Explosive Weight	Mine Weight	Mines Per 5 Ton Dump	Remarks
AT	M-56	Fielded	Helicopter drop	Pressure	Blast	Track	Yes	Yes	3.2 Lb	5.9 Lb	160/UH-1	USAREUR ONLY
	RAAMS (M-70/M-73)	Fielded	1. G force 2. Spin	Magnetic	M-S plate	Vehicle	Yes	Yes	1.3 Lb	3.8 Lb	9/Round	Fielded
	GEMSS (M-75)	Fielded	1. Spin 2. Electric impulse	Magnetic	M-S plate	Vehicle	Yes/No	Yes	1.3 Lb	3.8 Lb	1,600	A % of mines have anti-handling device
	Gator (BLU-91-B)	Production and Deployment phase	1. Bore pin 2. Electric impulse	Magnetic	M-S plate	Vehicle	No	Yes	1.3 Lb	3.8 Lb	N/A	45 per USN CBU 78, 72 per USAF CBU-89/B 94 mines per TMD-72 EA-918/22 EA-928
	MOPMS (XM-78)	Type classified	1. Bore pin 2. Electric impulse	Magnetic	M-S plate	Vehicle	Yes	Yes	1.3 Lb	3.8 Lb	30 Modules (630 mines)	Wire and radio initiation, Radio command destruct recycle
	Volcano (Air/Ground) (BLU-91/B)	Full scale development	1. Bore pin 2. Electric impulse	Magnetic	M-S plate	Vehicle	No	Yes	1.3 Lb	3.8 Lb	1,600 (EST)	Uses Gator mine. The unit of issue is the XM87 mine canister
	ERAM (BLU-101/B)	Developmental	1. Bore pin 2. Electric impulse	Acoustic /IR	Self forging fragment	300 FT	Yes	Yes	65 Lb	70 Lb	N/A	2 Skeets/Mine, 8/CBU 92/B. A USAF system
AP	ADAM (M-67/M-72	Fielded	1. G force 2. Spin	Tripwire	Bounding fragment	20 FT	N/A	Yes		0.9 Lb	36/round	Fielded
	GEMSS (M-74)	Fielded	1. Spin 2. Electric impulse	Tripwire	Blast fragment	40 FT	N/A	Yes	1.2 Lb	3.2 Lb	1,600	
	Gator (BLU-92/B)	Production and deployment phase	1. Bore pin 2. Electric impulse	Tripwire	Blast fragment	40 FT	N/A	Yes	1.2 Lb	3.2 Lb	N/A	15 per USN CBU 78/B, 22 per USAF CBU-89/B 94 mines per TMD 72 918/22 928
	MOPMS (XM-77)	Type classified	1. Bore pin 2. Electric impulse	Tripwire	Blast fragment	40 FT	N/A	Yes	1.2 Lb	3.2 Lb	30 modules (630 mines)	Wire and radio initiation, radio command destruction and recycle
	Volcano (Air/Ground) (BLU-92/B)	Full scale development phase	1. Bore pin 2. Electric impulse	Tripwire	Blast fragment	40 FT	N/A	Yes	1.2 Lb	3.2 Lb	320 (EST)	Uses Gator mines

SPECIAL PURPOSE MINES

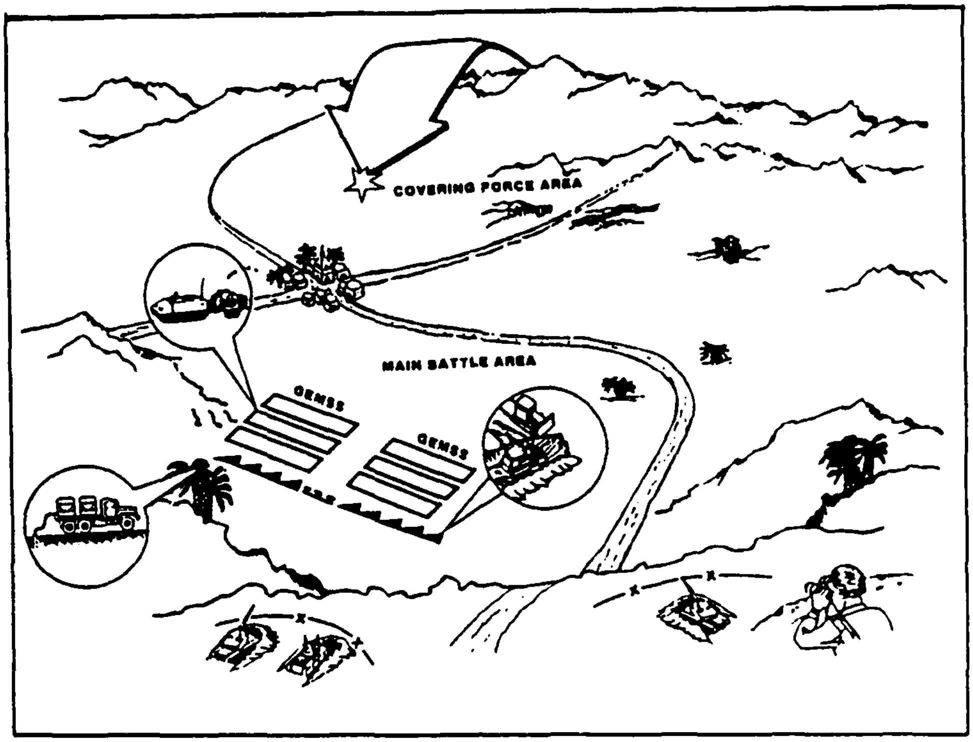
	Mines	Present Status	Arming	Fuzing	Warhead	Sensing Width	Anti-Handling Device	Self Destruct	Explosive Weight	Mine Weight	Mines Per 5 Ton Dump	Remarks
AT	WASPM (XM-84)	Full scale development	Manual	Acoustic /Radar	Self forging fragment	165 FT	Yes	Yes	12 Lb	35 Lb	70	Remote recycle, command destruct and will be compatible with the XM71 (RCU). Possible JSOR
AP	PDM (XM-86)	Developmental	Manual	Tripwire	Bounding	20 FT	Yes	Yes		1 Lb		Manually armed ADAM. Short self destruct only

MINE DISPENSERS

Dispensers	Requirement Document Status	Mines Used	Magazine Capacity	Dispenser Weight Loaded	Prime Mover	Remarks
159MM Howitzer	Fielded	ADAM, RAAMS	32 ADAM 24 RAAMS	Various	Various	"Magazine capacity" is basic load numbers of rounds 9 RAAMS RD, 36 ADAM/RD
M-56	Fielded	M-56	80	660 Lb	UH-1	USAREUR only, two per UH-1, hardpoints required
M-57	Fielded	M-15	288 per rack	3,235 Lb	Various 5 ton DT Trk	USAREUR only.
M-128 (GEMSS)	Fielded	M-74, M-75	800	15,000 Lb	5 ton truck Any Track	To be fielded in USAEUR in FY86
XM-131 (MOPMS)	ROC, Dec 1977	XM-77	21	150 Lb	N/A	Ground delivered, single dispenser being considered W/A 17AT & 4AP mix
XM-132 (MOPMS)	ROC, Dec 1977	XM-78	21	150 Lb	N/A	Ground delivered, single dispenser being considered W/A 17AT & 4AP
XM-138 (Flipper)	LR DARCON April 1982	GEMSS (M-74, M-75)	Manually fed		Various	GEMSS back-up system. Individual mines manually fed into dispenser
XM-139 (Volcano)	ROC AT HQDA	Gator (BLU-918/928)	240		Various	Four launcher racks per UH-60, 5 ton truck and M-548 ammo carrier

Source: Handbook of Employment Concepts for Mine Warfare Systems, p. 37

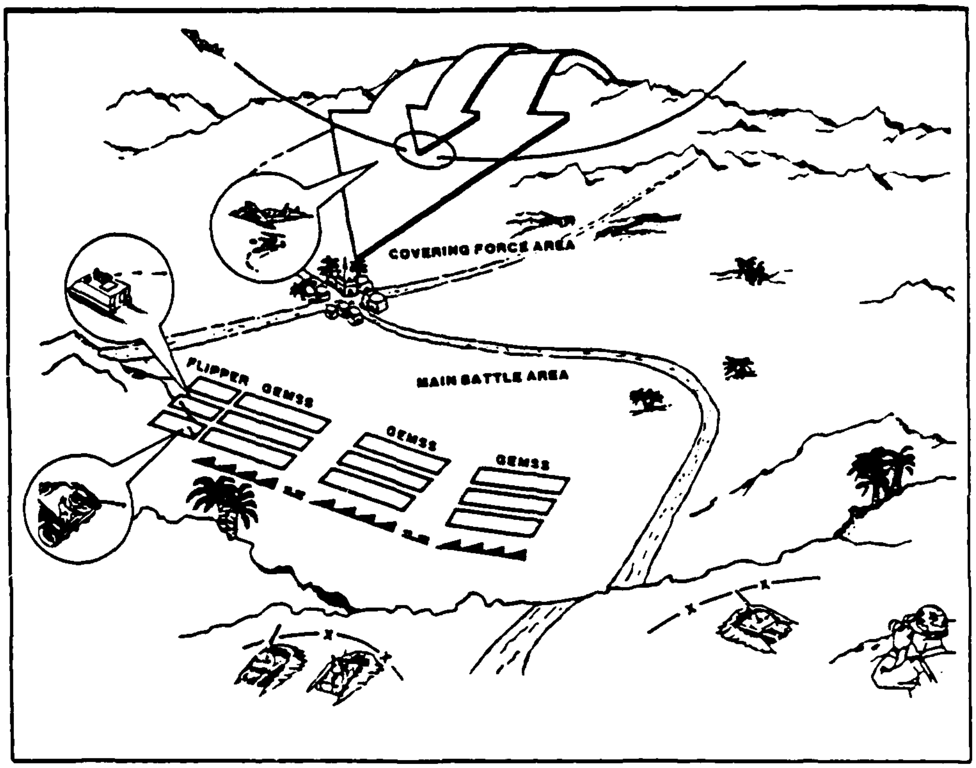
Appendix B: Scenario #2



Mine Scenario 2, illustration 2, depicts the efforts to emplace a four kilometer long tactical minefield between two steep kill masses backed with an antitank ditch. Because of the local availability of mines, only two M-128 GEMSS mine dispensers are able to be initially employed. The four Flippers, or the GEMSS auxiliary dispensers that are part of each GEMSS system, are not initially used, as their primary function is to back up the M-128 GEMSS dispenser.

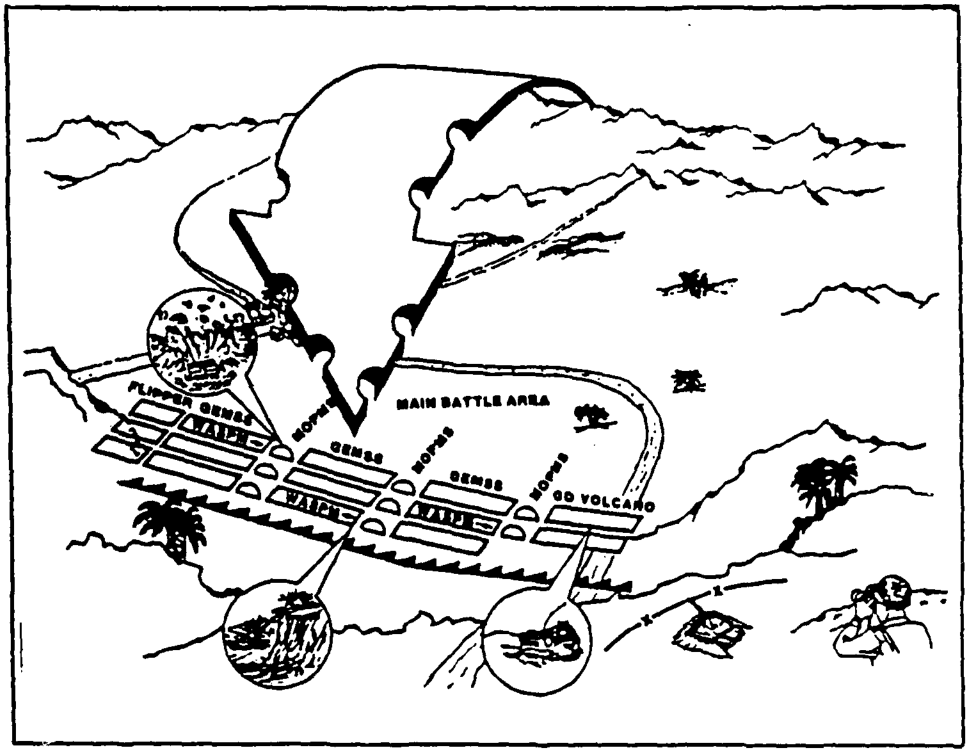
A squad of engineers can lay a belt of mines (at a ratio of 5:1, that is, 666 AT and 134 AP mines) consisting of three separate rows each 880 meters long and 60 meters deep. A GEMSS dispenser individually lays each row of mines. The mines do not arm until they have been on the ground for a period of time consistent with allowing troops marking the minefield and preparing the lanes to leave the area. Under ideal conditions it will take 45 minutes to pre-op, check and reload the dispenser with 800 mines. The GEMSS antitank mine has a magnetic influence fuze and will attack a target vehicle over its full width. The GEMSS antipersonnel mine, once armed, will dispense four trip wires, each to a distance of 40 feet. The mines self-destruct times are variable and the longest setting is consistent with the life of the mine's battery. The operator sets one of the two long self-destruct times on the dispenser. All mines are programmed for the specific self-destruct time as they are launched. Each three row GEMSS minefield laid, will provide an AT minefield linear density of 0.75 mines per meter of front. As the initial two GEMSS minefields are being completed, the Covering Force has engaged the enemy's first echelon forces.

Source: <u>Handbook of Employment Concepts for Mine Warfare Systems,</u> pp. 74-80.



Mine Scenario 2, illustration 3, shows the enemy attack has been slowed but has been successful in passing through the Covering Force area. A US Air Force air mission request is called in upon enemy follow-up echelon forces approaching the battlefield. This particular mission is satisfied with three A-10s each dropping six Gator dispensers on the columns of advancing armored and mechanized forces. One aircraft with six dispensers will effectively cover an area 650 meters by 250 meters with 432 AT and 132 AP mines.

The third GEMSS dispenser has been loaded with mines. There are now only 300 GEMSS mines remaining in the mine upload area. It is reported that Volcano mines will arrive in the brigade area within 30 minutes. It is decided to lay the remaining GEMSS mines with three of the Flippers in a difficult-to-traverse area extending 300 meters to the left of the first GEMSS minefield. Flippers can be mounted on a variety of wheeled and tracked vehicles and can lay six mines a minute. This will take three Flippers one hour to complete (upload, transportation, and mine laying times combined). A Flipper can be handled, mounted and used with the same relative ease as a medium sized outboard engine.

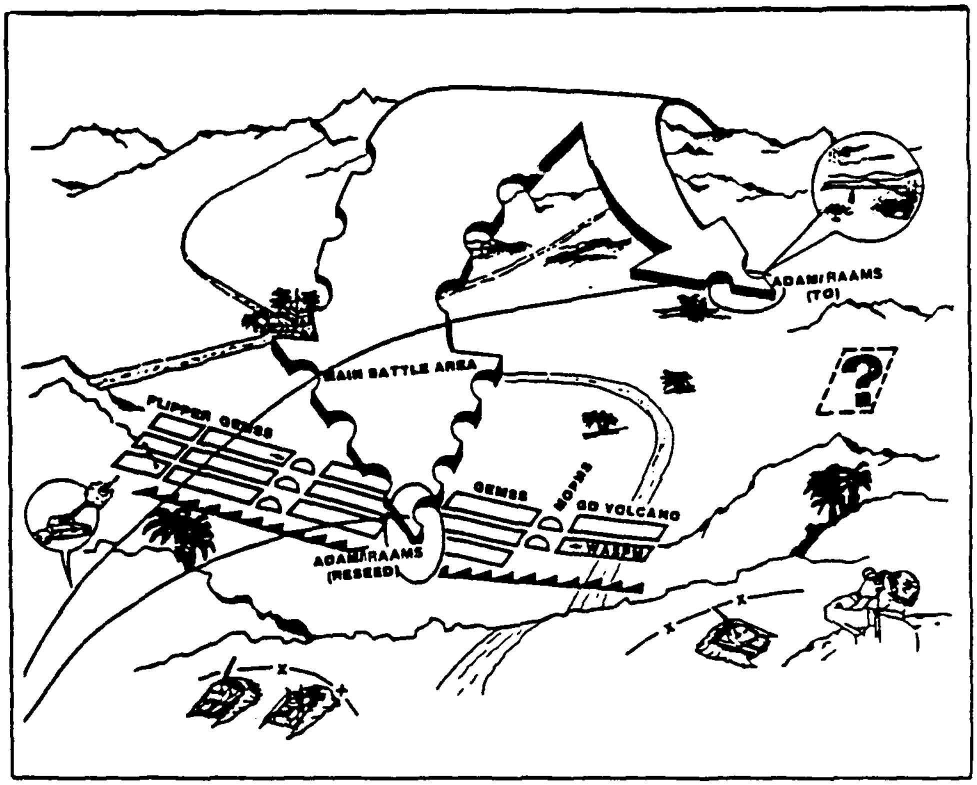


Mine Scenario 2, illustration 4, shows that the enemy attack has been weakened, but has passed through the Covering Force area and will soon encounter and engage forces in the Main Battle Area.

The Covering Force begins passing through the three designated lanes through the minefield and antitank ditch. Upon the complete passage of the covering force, the minefield lanes will be closed by MOPMS mines and the WASPMs. Each lane will have three MOPMS dispensers, coinciding with the rows in the GEMSS minefield, thus covering the lane with a total of 63 mines (51 AT and 12 AP). The WASPM is a horizontal effect mine hand emplaced in the minefield to cover lanes and likely avenues of approach. WASPM acquires its target acoustically and tracks / engages it by radar. It fires a single self forging fragment at a range of up to 50 meters. WASPM is an ideal mine to attack lead enemy countermine vehicles which first enter a friendly minefield. Both MOPMS and WASPM can be remotely self-destructed or have their self-destruct times extended using a common RCU.

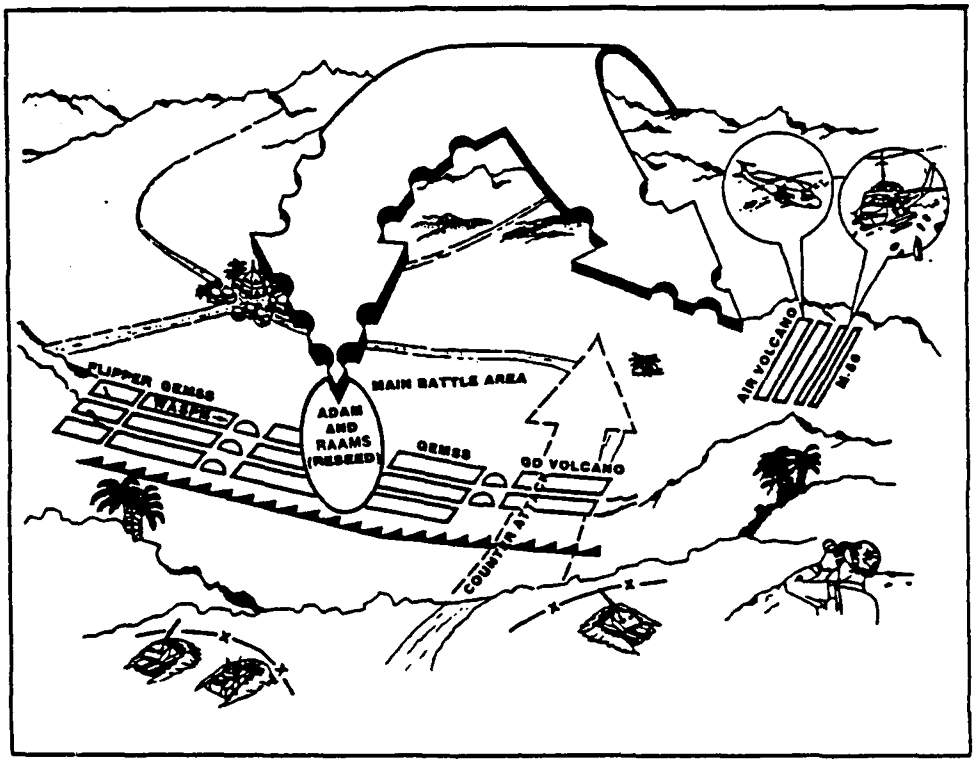
As the covering force passes through friendly lines, the final portion of the tactical minefield is laid by a ground Volcano mine delivery system mounted on a M-548. The 960 ground Volcano mines (800 AT and 160 AP mines) are laid in a third of the time it takes an equivalent number of GEMSS mines to be emplaced. In one pass down the center line of the minefield belt, ground Volcano lays its mines in two 40 meter rows. Once dispensed, the Volcano mines arm themselves quicker than the GEMSS mines. This is an important consideration since the Threat forces are close at hand and are being engaged at TOW ranges.

The enemy is below 70 percent of its original effectiveness but is still attacking.



Mine Scenario 2, illustration 5, shows the Covering Force has taken up positions in defense of the Main Battle Area, and the enemy has breached the tactical minefield. As the battle rages a follow-on echelon enemy unit moves to the right flank of the friendly forces. This is interpreted as an attempt to pass through a valley and outflank the US defenders. US forces plan to block the pass with mines and fire. Immediately, artillery delivered mines are brought to bear on the enemy. A high angle of fire 400 x 400 meters AT RAAMS and AP ADAM minefield module (288 RAAMS and 144 ADAM mines) is laid utilizing long self-destruct times in a reseed mission to close the enemy breach in the GEMSS tactical minefield.

The follow-on echelon is engaged as a target of opportunity to slow its progress using 155 millimeter fire to lay a RAAMS and ADAM minefield module. The RAAMS mines have the same characteristics as GEMSS, Gator, Volcano, and MOPMS AT mines. The ADAM mine is unique within the family of scatterable AP mines. Once armed, ADAM activates at least three of its seven 20 foot tripwires. ADAM's fragmentation kill mechanism is propelled upwards, when it senses a target through the tension on a tripwire, making it extremely lethal.



Mine Scenario 2, illustration 6, shows that the effectiveness of direct and indirect friendly fires has been enhanced by the minefield and antitank ditch obstacle system, providing a synergistic effect that has blunted the enemy's main attack. The integrity of the minefield has been restored, but the possibility of friendly forces being outflanked still exists.

second Blackhawk will lay the remaining portion. Aircraft vulnerability, under this circumstance, is kept low. The entire dispensing operation takes less than three minutes. Behind the air Volcano minefield, UH-1 Hueys will lay a second minefield of M-56 pressure fuzed/track braking AT mines, which have a single factory set self-destruct time. A UH-1 must fly at twice the altitude of a Blackhawk when laying mines and can carry only one fifth the mine payload in a single sortie. Each UH-1 M-56 mine sortie will dispense a row of mines 800 meters long and 20 meters wide. The M-56 dispensers are attached to the four UH-1s. The UH-1s fly to the area where the minefield is to be emplaced and lay two rows of mines each 1500 meters by 20 meters, providing a linear density coverage of 0.4 mines per meter of front.

The enemy force encounters an effective friendly defense in the region just reinforced with the helicopter delivered mines and is stopped. The initiative is now in the hands of the friendly combined arms team.

Appendix C: The FASCAM Triad

			Designed to Self-Destruct	Emplacement Remote (R) Direct (D)	Pattern (P) Non-Pattern (N)
GROUND	HAND	(AT) M15/M19/M21/M24 - (AP)M14/M16/M18	NO	D	P/N
		WASPMS	YES	D	N
	MECHANICAL	surface Planted (subsurface) M15 AT only	NO	D	N
		Thrown (surface) GEMSS/FLIPPER	YES	R	N
	EXPLOSIVE	MOPMS	YES	R	N
		VOLCANO	YES	R	N
ARTILLERY		ADAM/RAAMS	YES	R	N
AIR		High Performance A/C GATOR/ERAM	YES	R	N
	HELICOPTER	MECHANICAL - M56	YES	R	N
		EXPLOSIVE - VOLCANO	YES		N

Source: FM 5-102 Countermobility, p. 82.

Appendix D: Fielding Schedule for Near-Term FASCAM Systems

FIELDING OF NEAR-TERM MINE SYSTEMS

System	Initial Fielding Date	Initial Fielding Location	Basis of Issue
GEMSS			
M128 Launcher	Fielded	9ID/Ft. LW	1/Combat Engineer Company in Heavy Force
XM138 Flipper	2QFY87		4/M-128 and in Light Force Platoons
M74/75 Mines	Fielded		
VOLCANO			
Ground Launcher TC (LP)	1QFY89	9ID/7ID	1/Combat Engineer Company
Air Launcher TC (S)	1QFY89	9ID	3 Per CSAC
Ground Launcher TC (S)	4QFY89	USAREUR	1/Combat Engineer Company
Mine Canisters	1QFY89	9ID/7ID	
MOPMS	3QFY88	Class V Item	4 RCUs/Engineer Company 2 RCUs/Armored & Infantry Company
WASPM	Unfunded for Procurement	Class V Item	WASPM will use same RCU as MOPMS
PDM	4QFY89	Class V Item	Available only to SOF

Acronyms:

- Ft. LW — Fort Leonard Wood
- TC — Type Classification
- LP — Limited Production
- S — Standard
- CSAC — Combat Support Aviation Company
- RCU — Remote Control Unit
- MOPMS — Modular Pack Mine System
- USAREUR — United States Army Europe

Source: <u>Handbook of Employment Concepts for Mine Warfare Systems</u>, p. 9.

Appendix E: Logistic Characteristics of Conventional and FASCAM Mines

Type	Mine Weight (Lbs)	Type Packing	Packing Weight (Lbs)	Quantity of Mines per Pack	Packaged Volume (Cu Ft)	Packing Dimensions (Inches)	12-ton M Truck Ca (Mines)
Conventional							
M15	30.00	Crate	49.0	1	1.18	18 x 15 1/8 x 7 1/2	489
M21	18.00	Crate	90.8	4	4.12	22 1/8 x 20 1/8 x 16	976
M19	28.00	Crate	71.8	2	1.57	16 3/8 x 10 3/8 x 16	668
M16	8.25	Crate	44.8	4	0.78	15 5/8 x 10 1/8 x 8 1/2	2,140
M14	0.21	Crate	44.1	90	1.73	19 3/4 x 17 1/4 x 8 3/4	48,960
FASCAM							
M56	5.60	Reload Kit	755.0	80 per Kit	12.60	37 1/2 x 32 1/4 x 18 3/8	2,48[illegible]
		Dispenser and Container	1,360.0	80 per Dispenser and Container	59.70	104 x 31 1/2 x 31 1/2	1,28[illegible]
ADAM	0.90	Palette	874.0	8 Rounds (36 Mines Ea)	9.60	14 5/6 x 29 1/8 x 39 3/8	[illegible]
RAAM	5.00	Palette	875.0	8 Rounds (9 Mines Ea)	10.10	14 5/8 x 29 1/8 x 40 7/8	1,94
GEMSS	3.20 (AP)	Palette	1,267.0	6 Containers, 40 Mines per Container	31.60	43 x 55 x 23 1/8	4,32
	3.80 (AT)	Palette	1,453.0		31.60	43 x 55 x 23 1/8	3,84
MOPMS	3.70	Paletre	1,070.0	6 Modules, 21 Mines in Each Module	49.00	34 x 53 x 47	2,52

SOURCES: DA, HQ, FM 5-34, Engineer Field Data; DA, HQ, FM 5-35, Engineer's Reference and Logistical Data; DA, HQ, TM 9-5 Data Sheets for Ordnance Type Material; Mr. Dan Willis, Storage a[illegible] Outloading Division, US Army Defense Ammunition Center School, Savanna, Illinois; and Mr. Dick Gyure, Development Project Office for Selected Ammunition, P[illegible]atinny Arsenal, Dov New Jersey.

Appendix F: FASCAM Procurement Program (as of FY 1982)

	Prior	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	Total	AAO
ADAM										
Q(K) M692	12.0	3.0	5.0	5.0	5.0	5.0	5.0	9.0	49.0	49
Q(K) M731	28.0	3.0	5.0	11.0	11.0	11.0	11.0	7.0	87.0	88
$ Millions	199.2	26.77	51.0	73.4	74.6	74.7	76.6	78.9	654.9	--
RAAM										
Q(K) M718	10.0	6.0	13.0	12.0	15.0	14.0	16.0	16.0	102.0	142
Q(K) M741	18.0	7.0	12.0	13.0	13.0	10.0	14.0	14.0	101.0	302
$ Millions	69.6	29.9	62.8	57.1	62.3	53.5	68.3	70.3	473.8	--
GEMSS Dispenser										
Q (Each)	0	4.0	0	23.0	24.0	0	54.0	24.0	129.0	495
$ Millions	0	5.0	0	12.4	9.1	0	20.9	9.5	56.9	--
GEMSS Mines										
Q(K) M74 (AP)	0	4.0	6.0	23.0	11.0	19.0	17.0	24.0	104.0	174
Q(K) M75 (AT)	0	8.0	20.0	47.0	26.0	42.0	41.0	54.0	238.0	343
$ Millions	0	7.9	13.2	34.9	18.6	28.5	27.9	38.1	169.1	--
GATOR										
Air Force										
Dispensers (Each) (See Note 3)										
Navy Dispensers										
With Mines (Each)	0	0	0	0	0	1,100.0	1,300.0	2,105.0	4,505.0	8,734
$ Millions	0	0	0	0	0	36.8	46.7	81.7	165.2	--
MOPMS										
Modules	0	0	0	0	0	1,080.0	3,856.0	5,589.0	10,525.0	20,681
$ Millions	0	0	0	0	0	18.1	44.6	58.2	120.9	--

NOTES:
1. Q refers to quantity and K to thousands.
2. M56 was fielded in FY 78 for $39.3 million. Replacement M56 batteries are being purchased b USAARRCOM.
3. Air Force GATOR procurement was not programmed in FY 82-86 POM.
4. The Marine Corps is purchasing small quantities of ADAM (11,000) and RAAM (18,000) beginning i FY 80. Total procurement cost for the Marine Corps is $16.6 million through FY 86.

SOURCES: DA, HQ, FY 82 budget submission; DN, HQ, October 1980 Update of the FYDP; Marine Corps, FY 82 OSD OMB submission, Budget Activity 1.

Appendix G: Offensive Mine Warfare Doctrine

Type Operations	Type Mine System						
	Conv	ADAM	RAAM	GEMSS	GATOR	MOPMS	M56
Movement to Contact							
Supplement Flank Security Forces	X	X	X				X
Block High-speed Approaches		X	X				
Hold Main Enemy Forces in Objective Area		X	X				
Suppress/Contain Enemy Security Forces		X	X				
Hasty/Deliberate Attack							
Isolate the Objective		X	X				
Suppress Adjacent Strongpoints		X	X				
Block Routes of Counterattack and Reinforcement	X	X	X		X		X
Hinder Withdrawal of Enemy Forces		X	X		X		X
Prevent Enemy Maneuver to Counterattack		X	X		X		
Interdiction of Enemy Second Echelon Forces in Assembly Areas and Columns		X	X		X		
Attack Reserves in Depth					X		
Deny High-speed Routes of Advance		X	X		X		
Disrupt and Destroy Support and Command Facilities		X	X		X		
Counter Indirect Enemy Fire Units		X	X				
Economize Forces in Adjacent Areas	X	X	X				
Exploitation and Pursuit							
Stop, Isolate, and Prevent Enemy Withdrawal or Reinforcement		X	X		X		
Protect Friendly Force Flanks		X	X				X

SOURCES: 1. FM 5-100, FM 20-32, FM 90-7, TC 20-32-2, TC 20-32-3, TC 6-20-5 and TC 20-32-4.
2. Marine Corp GATOR Concept.

Appendix H: Defensive Mine Warfare Doctrine

Type Operations	Type Mine System						
	Conv	ADAM	RAAM	GEMSS	GATOR	MOPMS	M56
CFA							
Block High-speed Avenues of Approach	X			X	X		X
Thicken Obstacle Plan at Small, Selected Points Between CFA and MBA	X				X		X
Establish Tactical Minefields to the Rear of CFA Forces	X			X			
Close Gaps and Lanes		X	X			X	X
Reinforce Conventional Obstacles		X	X	X	X		X
Employ Phony Minefields	X						
MBA							
Deny High-speed Approaches	X			X	X		
Direct and Canalize Enemy Into Kill Zones	X	X	X	X	X	X	
Provide Flank Security	X	X	X	X	X	X	X
Close Enemy Breaches		X	X				
Counter-battery Suppression		X	X				
Interdiction of Second Echelon Forces and Assembly Areas		X	X		X		
Rear Area							
Protective Minefields for Depots, etc.	X						
Delay and Canalize Enemy	X			X			
Attack Enemy Drop Zones/Landing Zones and Assembly Areas		X	X		X		

SOURCES:
1. FM 5-100, FM 20-32, FM 90-7, TC 20-32-2, TC 20-32-3, TC 6-20-5, and TC 20-32-4.
2. Marine Corps GATOR Concept.

Appendix I: Mine Effectiveness Comparison

MINE EFFECTIVENESS COMPARISON
(Based on Manpower to Emplace)

Type Mine	Index of Mine Effectiveness a/	Squad-hours Per Mine	MOE (Quantity X Squad-hours)
AT			
GEMSS	1.7	0.003910	0.0066
MOPMS	1.7	0.004670	0.0079
M15 w/M57	2.1	0.007194	0.0151
M21	1.0	0.034750	0.0348
M19	2.1	0.034750	0.0730
AP			
GEMSS	1.2	0.003910	0.0047
MOPMS	1.2	0.004670	0.0056
M16	1.0	0.017400	0.0174
M14	270.0	0.008700	2.3490

a/ Numbers of mines needed to equal in effectiveness one standardized mine (M21 for AT, M16 for AP).

Source: Kishyama, Michael M. et al, "An Assessment of the Family of Scatterable Mines (FASCAM) Program." (Secret- Unclassified Excerpts), p. 15.

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